

Narration

Mars Network Video for Planetfest

Title: Mars Network: A Proposed Infrastructure to Support the Future Exploration of Mars (JPL, NASA logos)

1. Pan of "The Coming Decade of Mars Exploration" VG (TBS)

In the coming decade, an international armada of landers, rovers, orbiters, and aerobots are scheduled to descend upon Mars, carrying out the most intensive exploration to date of another planet in our solar system. In 2003 and 2005, Mars Sample Return missions will deploy landers and rovers to collect Martian surface samples and launch them into orbit about the Red Planet. A Sample Return Orbiter also launched in 2005 will rendezvous with and return these samples to Earth, arriving here in 2008. In 2005, the French space agency (CNES) will deploy a network of four small landers, conducting meteorological, seismological, ionospheric and geodetic experiments. In addition, small, low-cost micromissions may be deployed to allow an even broader range of science investigations. And in the longer term, NASA is studying the concept of robotic outposts – sites of permanent robotic presence on the Mars surface.

2. Pan of "Mars Network" VG (TBS)

To support this wide range of missions, NASA is exploring the concept of a Mars Network, a constellation of orbiting satellites providing breakthrough increases in communications capability and navigation accuracy to future Mars science missions. With the potential for more than three orders-of-magnitude increase in data return relative to Mars Pathfinder, the Mars Network will truly establish a virtual presence on Mars, changing the way we conduct science on the Martian surface and providing new ways for the public to experience the excitement of Mars exploration.

JPL has worked with Analytical Graphics to generate the following computer simulations of the Mars Network, helping to visualize its evolving benefits.

3. Communications.mov

In one scenario under study, the first element of the Mars Network would arrive at Mars in December, 2003 and begin to provide relay telecommunications and navigation services to NASA's 2003 Mars Sample Return rover and the ESA's Beagle II lander. From its near-equatorial orbit, this small, low-cost Mars Network microsatellite would be well-positioned to contact those surface spacecraft and relay their data back to Earth. As the Mars Network orbiter passes overhead, the surface spacecraft would transmit their data at high rate using simple, energy-efficient UHF communications. And similar to the Earth's Global Positioning System, careful tracking of these UHF radio signals will allow position determination of the surface spacecraft at an accuracy of about 10 meters. After the pass, the Mars Network orbiter would then relay the lander data back to Earth using its high gain antenna.

4. Microsat.mov

Over a series of Mars launch opportunities, additional microsatellites could be added to the Mars Network to increase data return, frequency of contact, and overall robustness of the Mars telecommunications infrastructure. The first microsatellite, in its near-equatorial orbit, will provide 10 contacts and hundreds of Mbits of data return per Martian day for low-latitude users like the planned 2003 and 2005 sample return missions, representing an order-of-magnitude improvement relative to Mars Pathfinder.

In one scenario under study, two additional Mars Network microsatellites would be deployed in each subsequent Mars launch opportunity. Thus by 2006, with one of these spacecraft placed in an inclined orbit, the resulting three-satellite constellation would now provide truly global coverage, with enhanced support of the low-latitude bands. Data return would surpass a Gbit per Martian day, and low-latitude users would see an element of the network roughly once every hour.

Continuing with this scenario, the constellation would continue to grow with additional launches in 2007 and 2009. By the end of the decade, the Network would consist of six satellites, two in near-equatorial orbit and four in inclined orbits, providing balanced global coverage, with 20-30 contacts each Mars day and data return approaching 10 Gbits per sol. This increased data return could support the return of hourly high-resolution panoramic images from long-range rovers and aerobots, each of which would have taken days or weeks to return with Pathfinder's limited communications capabilities.

5. MARSat.mov

In addition to these low-altitude microsatellites, another concept being studied for the Mars Network is a Mars Areostationary Relay Satellite, or "MARSAT". Like a geostationary satellite at Earth, MARSAT would fly in a circular orbit above the Mars equator, with an orbit period equal to the Mars rotation rate, and thus have a continuous view of one hemisphere of the planet. And much like the satellite TV systems available here, a Mars surface user would deploy a small, fixed antenna to establish a high-performance link to MARSAT, which would always be in view at a fixed location on the sky. MARSAT is designed to support a 1 Mbit/sec link from the surface of Mars and a 1 Mbit/sec link back to a DSN antenna on Earth. This combination of high bandwidth and near-continuous connectivity opens up the exciting possibility of streaming video from long-range rovers or aerobots as they traverse the Martian terrain. With potential data return of nearly 100 Gb/sol, MARSAT would provide more than a thousand-fold increase in data return capability relative to Mars Pathfinder, and would enable humanity to truly begin to establish a "virtual presence" on Mars.